Fabio Cifariello Ciardi , 1997 " Retrieving Long Term Memory traces in contemporary music listening: a composer view " Atti della Third International ESCOM Conference, Uppsala - Sweden. pp.91-96

Retrieving Long Term Memory traces in contemporary music listening: a composer view

Fabio Cifariello Ciardi
Conservatorio "L.Perosi" - Campobasso
via Pietro Giannone, 28 - 00195 - Roma ITALY
e-mail: f.cifariellociardi@agora.stm.it

1. Introduction

Human memory represents a central area of psychological research and, in general, a fundamental issue for understanding human communication processes. Composers light be interested in evaluating listeners memory processes in order to optimize communication of their aesthetic and poetic ideas. However, composers consideration of memory is often ambiguous, as while they understand that the possibility to grasp structural invariance of a piece of music depends on short-term memory (STM) and long-term memory (LTM) interactions, nevertheless they seldom examine the role of LTM in musical experiences closely. LTM refers to knowledge which is already storedwhile composers ideally tend to explore original, unknown territories. Many reasons might justify composers' attitude towards Tulving's distinction of LTM in episodic and semantic memory . Episodic memory is scarcely significant in composition because of its mainly autobiographical nature (i.e., episodic memory is a personal, unique wisdom which often looses its consistency when applied to large groups of people); on the other hand, remarks about semantic memory are often avoided in order to refrain from facing the puzzling issue of musical semantics.

Today, however, reconsidering the influence of LTM on music listening might be useful for aesthetic, ethical and even political reasons (Cifariello Ciardi, 1994), but even simply for a better evaluation of the cognitive "weight" of music materials. Furthermore, New Media urgently call for such an evaluation: a better understanding of storing and retrieving processes is clearly helpful in the organization of the huge sonic universe now available by means of digital technology.

2. Denotation, connotation, commonness of sonic events

Composers are more interested in the unstable zone between expected and unexpected sonic events, rather than in the listener's recognition of specific musical items. What composers might wish to investigate is the possibility to influence, by means of appropriate compositional techniques, the way listeners retrieve LTM traces. That is, composers are interested in controlling the semantic quality of sonic events in order to improve the “depth” of their acoustic space (i.e., a depth defined by a figure-ground perspective). This kind of control might be helpful in shaping subject's attention, strategies and expectations while listening to music genders based on non-traditional materials and syntax.

In order to assign semantic qualities to an acoustic stimulus, sensorial processing must activate structures of semantic components stored in LTM. As LTM structures and elements may be

represented by semantic networks, activation of previously learned information may be described as a process of semantic features correlation. Within this framework, the "meaning" of sonic events is the result of structures of semantic components which may emerge from such a correlation process. From a semiological point of view, by means of this process, the subject may interpret a stimulus as a sign (i.e., a mental construct provided with a specific meaning). The mental representation of the sign will primarily lead the subject to **denotate** the stimulus, giving by this way an immediate meaning, and subsequently **connotate** the same stimulus giving a secondary meaning that arise from the first.

Denotation might refer to the result of the very first correlation of the sign with previously learned knowledge of the subject, while connotation might be considered as the result of subsequent correlations. Thus far, denotation and connotation have been used here in a quite broad sense: they indicate the result of any semantic features correlation with sensory data, rather than specific goals of semantic encoding (e.g., recognition of the cause that produces the stimulus, identification of the function of the stimulus within a certain context, recall of an appropriate noun).

Strictly speaking connotation of a sonic event is quite a subjective attribute; nevertheless, if a stimulus would activates - among others - analogous semantic features within a group of subjects, we might hypothesize that a **commonness** in subjective connotations was elicited. The eventual emergence of connotation commonness depends on the number of subjects that associate the stimulus to a common set of semantic components. Moreover, connotation commonness might be related to the number of interconnected semantic features: the more interconnected semantic features activated by the stimulus are, the more evident the strength of connotation will be and the stronger commonalities will emerge. For example, single tones of well-known musical instruments might give rise to simple common connotations (e.g., the common connotation of a piano tone might refers to the musical instrument that produced the sound), while more complex shared connotations are difficult to be considered.

On the other hand, a stronger convergence towards more interconnected semantic features might be expected in case of different types of sounds, although immediate correlations might still be difficult to foresee.

Considering a well-known musical theme, a scream, a car beep, the sounds of wind or rain, a shared connotation might be predicted. Such connotation might be based on a relatively small number of common semantic components highly interconnected in some analogous way within the memory network of each member of the group. Commonalties among subjective connotations might refer to various type of cognitive activity: abstract or procedural knowledge, emotional or motorial response. However, what remain clear is that different cognitive (and biological) structures may lead to similar cognitive responses, thus implicating somehow analogous semantic encoding (e.g., different subjects might regard a sonic event as a shared concept more than subjective percept).

Our claim is that strong common connotation of any sonic event implies encoding modalities and semantic effects closely related to those that arise in long-term verbal memory.

Connotated sonic events have hardly been studied as a whole. However, since well-known melodies may be considered as a commonly connotated sonic event, results from literature on well-known melodies memory representation (e.g., Dowling & Harwood, 1986; Halpern, 1984) may be used to evaluate the aforementioned assumption. Among others, evidence for a parallelism between well-known melodies and word-list encoding modality comes from experiments by Gardiner et al. (1990). Their results show that the stable relation between

recognition and recall (Tulving-Wiseman law) is not restricted to verbal material, but is extended to familiar melodic excerpts.

Considering commonness connotation as an index of a class of sonic events, two distinctive features ought to be emphasized. First of all, such a class of connotated sonic event will include a wide range of sounds produced by very different media: sounds from a natural environment as well as sound produced by human being or objects for various reasons. Secondly, connotation can be described on a relative scale only. That is, connotation refers to commonalities that emerge within a group of subjects (i.e., a **reference group)** that agree on specific semantic qualities of an event.

Consequently, common connotation of a sonic event might be defined on a statistic basis by taking into account its stability in time and space domain: common connotation of a sonic event may be strong for a certain period of time and weaker after that time. For instance, the sound of horse-drawn coach was probably much more connotated before Industrial revolution than in the present-day word. Nevertheless, despite the uncertain edge of a class of commonly connotated sonic events, the definition of the issue seems to be plausible throughout analysis of sonic landscape invariances (cf. Murray Schafer, 1977). A higher rate of constancy and invariance within a certain time and a certain space will probably lead to a stronger and more common connotation. In this sense, contemporary world represents an exceptional ground for sonic connotation inquiries: common auditory experiences in the present-day multimedia society are frequent; this means that, today more than in the past, we might expect to encode sonic experiences in a more tangible common memory network.

3. Cognitive parameters in sonic connotation

Composers might gain several advantages from investigation on connotated sonic events cognitive processing. If semantics plays a crucial role in listening to a connotated sonic event it means that composers could set up an appropriate compositional processes in order to take advantage of effects related to semantic encoding of sonic materials. As an example, experimental evidence on semantic encoding of verbal items points out that our cognitive system produces faster responses for semantically encoded information (e.g., listener cognitive processing of recognizable inputs is faster than cognitive processing of non-recognizable inputs) (cf. Chang, 1986 for a review). Hence, if known aspects of a sonic stimulus are processed faster than unknown ones, than composers may control processing time in music perception through connotation control. That is, composers might use connotation in such a way as to stimulate and convoy listener's attention towards specific aspects of the musical piece. In order to do this, a central issue regards the physical correlates of a specific semantic quality. The question than arise as to what extent parameters could be modified leaving connotation relatively intact.

The modification of any physical parameter of a connotated sonic event may result in a variation between two boundaries. On one side, connotation strength may remain almost unaffected by parameter modification; that is, modified sonic events will activate semantic features similar to those activated by the original connotated event. On the other side more dramatic modification of the same physical dimension might irreparably corrupt sonic event connotation; this means that closeness among semantic features of both modified and original sonic events will not be detected. Therefore, we may argue that a physical parameter might erase sonic event connotation whenever parameter modification exceeds a certain threshold.

Connotation control in composition depends on the localization of such **connotation thresholds**. Conditions which determine connotation thresholds may refer to subject's timeless knowledge as well as to time-dependent factors which influence attention or emotional state.

Since consistent commonalities among subjective variables are unpredictable, composers tend to ignore the issue. However, connotation thresholds may also depend on subject-independent factors. Acoustical attributes and context distinctive features may contribute to define connotation thresholds. Within this framework composers may wish to control those parameters that seems to be critical in order to common connotation detection; that is, they may want to control parameters which seem to be perceptually salient for any member of the reference group. Therefore, we may pose the following question: can we determine a common "connotative weight" of a sonic event acoustic parameter?

Stable relations between connotation and its physical correlates are difficult to establish. Connotation of a percussion tone depends on amplitude envelope rather than on event length; on the contrary, considering wind sound connotation, we might tend to assign a higher "weight" to the event length and a lower "weight" to the amplitude envelope. Moreover, a straightforward application of theories about music cognition is not always useful to answer the question. For instance, "connotative weight" of pitch transposition seems to change over different sonic event categories. Empirical findings show that relative pitch chroma plays the most important role in memory for familiar melodies rather than absolute pitch (W. J. Dowilng & D. L. Harwood, 1986 for a review). These results suggest a low "connotative weight" for pitch transposition. However, for other sonic categories (e.g., animal sounds) we may assume that absolute pitch information is more accurately stored in LTM. If this is the case, absolute pitch transposition would easily corrupt sonic event connotation.

Generally speaking, "connotative weight" of acoustic parameters may be assigned on a cognitive-efficiency basis: critical parameters in sonic event connotation might be those which could lead the subject towards an efficient answer to the expectations usually correlated with that sonic event. This assumption may explain the reason why less significant parameters in musical experiences, such as amplitude and sound localization, become critical in natural environments .

Apart from subjective variables, connotation arousal is highly correlated with subject's exposure time to the stimulus. Under certain conditions connotation almost immediately emerges, while in other situations a longer time-span seems to be necessary to guarantee a reliable semantic qualification. Consequently we may argue that, since connotation stems from semantic correlation activity, connotation assignment may be considered as a time-dependent process: the longer the exposure to a sonic event, the stronger the connotation will be. This suggests that by means of an exposure time control, composers could control the chance that a connotation assignment will take place. Moreover, whether sufficiently long exposure to a sonic event may give rise to shared connotations, shorter exposure to the same event will probably activate episodic and semantic encoding which leads to much more subjective responses.

As previously mentioned, connotation assignment is influenced by external conditions. Context-dependent factors may influence connotation thresholds through a sort of **semantic masking**. Under certain conditions it is possible that interferences in semantic encoding will take place when a connotated sonic event is either preceded, or followed, or superposed to an other sonic event. In this case connotation strength might depend on both subject-dependent and subject-independent factors. Presumably, the more complex and robust the semantic network that represents the connotated event is, the more interference-resistant the connotation will be. Yet, the possibility to preserve connotation will be related to the subject's attention and expectations: as classical Cocktail Party phenomenon suggests, we may expect that subjects can almost "shadow" or ignore one sonic event while processing the other one. On the other hand, selective

attention and semantic masking are probably related to subject-independent factors as well. For instance, structural coherence between sonic events seems to play a central role in connotation detection. The more acoustic analogies exists between two differently connotated events, the more difficult the single connotation detection will be. From a compositional point of view, semantic masking is an other controllable process that might be used to shape sonic materials connotation.

4. Shaping sonic connotations in musical composition

In one of author's pieces, *Altre Tracce* for Bb clarinet (Cifariello Ciardi, 1991-2), exposure time and semantic masking have been considered with the purpose of affecting listeners' semantic encoding. Two groups of well-known melodic excerpts have been used as connotated sonic events. The first group includes, among others, the opening theme from W. A. Mozart's K.550 symphony, the main theme of G. Rossini's *Barbiere di Siviglia* and the second theme from Rossini's *La Gazza Ladra* overture. The common feature among all excerpts of the former group is a pattern of two or more repeated notes embellished by a descending and an ascending minor second. The second melodic group includes the *Seguidilla* from G. Bizet's *Carmen*, a prominent secondary theme from Debussy's clarinet and piano *Premiere Rapsodie* and the jazz standard *The Lady's a Tramp*. The common feature among all excerpts of the latter group is an embellished segment of a descending chromatic scale. The piece proposes continuous oscillations among connotated melodic fragments and more “neutral” gestures based on a 12-tone row derived by merging the two groups of excerpts.

In the first section of the piece two sonic streams are alternatively presented. The first stream tends to break over the *Barbiere di Siviglia* theme four time, while the second stream points at Bizet's *Seguidilla*.. First and second (Example 1) appearance of *Barbiere di Siviglia* theme is normally too short in order to permit recognition or connotation detection. In the successive exposition the same theme is still obscure because of the exclusion of the initial three-notes segment (Example 2). However, in both cases the sonic stream is always broken over in the same pitch region. The goal of the polarization is to generate listeners' expectation associated to a specific register.

During the third exposition listeners often recognize the theme. This means that the excerpt connotation has emerged from nearby sonic materials (Example 3). Here, connotation detection may depend on three factors. Firstly, the length of the third exposition is such that common correlations emerges. Secondly, previous Rossini presentations contribute to the subject's pre-activation. Thirdly, semantic masking is avoided by means of contrasting structures of standing by events.

An important secondary effect of connotation assignment in music listening is a sort of semantic “dissonance” between a connotated events and other neighboring ones. That is, semantic encoding of the two events may activate concept nodes which are semantically far one from the other (e.g., interconnection between connotate and “neutral” events memory networks may be difficult to establish). Consequently, a strong loss of global coherence may be detected by the subject. Hence, where efforts have been made to facilitate connotation assignment, other compositional techniques have been used to smooth passages between connotated and more “neutral” events. Firstly, hidden anticipation of Rossini's theme's salient features (Example 1 and 2) has been intended as a “preparation” to the third recognizable exposition of the excerpt. Secondly, since pitches of the connotated sonic materials are embedded in the “neutral” 12-tones row, collage-effects might be attenuate if underlying structural links are detected. Once

connotation has been confirmed, it has been faded out by means of a progressive semantic masking.
Finally, according to author's empirical results connotation may play a role in stream segregation. The typical loss of a sense of temporal order across two different streams seems to increase when connotation of the two streams is different. This assumption has been tested in an other section of the piece (Example 4). Listener responses suggest that connotation may be used as an extra-cue in interleaved melodies identification. This result is coherent with Hartmann and Johnson conclusions (Hartmann and Johnson, 1991): although peripheral channeling is the dominant characteristic in stream segregation, other central processes - as semantic encoding of connotated sonic events - might arise.

4. Conclusion

This paper is an attempt to point out how and why composers and music theorists should thoroughly examine the encoding modalities of well-known sonic events. The result of the author's empirical studies leads to the following conclusions.
1) Connotation can be usefully considered to index semantic encoding of a relatively large class of sonic events.
2) Commonness among subjective connotations may be predicted trough a statistical sonic landscape analysis, and may lead to the definition of a class of commonly connotated sonic events.
3) For each acoustic parameter of a connotated event, a threshold may be assumed in order to define to what extent parameter modification will not corrupt connotation assignment.
4) Digital Sound processing as well as appropriate compositional techniques may supply creative control on exposure time, masking effects and other factors related with connotation detection.
We are aware that many of the aforementioned assumptions are hypothetical and speculative ones and they need to be corroborated by a great amount of theoretical evaluation and empirical research. Nevertheless we hope that they might renew psychologists interest in the study of contemporary and electronic music sonic materials.

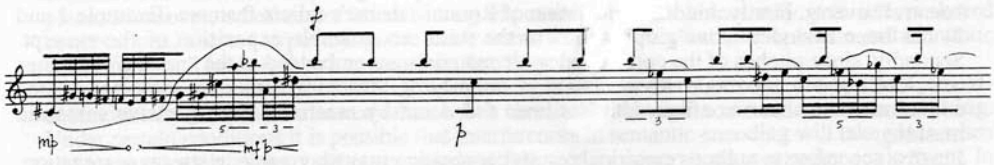
5. Acknowledgments

The author would like to thank Prof. Olivetti Berardinelli for her valuable criticism to the manuscript.

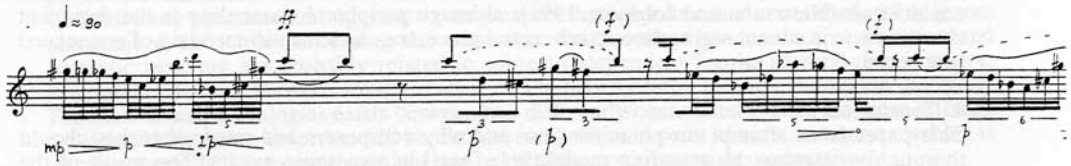
6. References

Bregman, A.S. (1990) *Auditory scene analysis*. Cambridge: MIT Press.
Chang,T.M.(1986) Semantic Memory:Fact and Models,*Psychological Bull.*, vol.99 n.2,199-220.
Cifariello Ciardi, F. (1991-2) *Altre Tracce* for Bb clarinet. Rome: Edipan
Cifariello Ciardi, F. (1994) Sentieri Convergenti? Musica e memoria ai limiti della costellazione postmoderna in *Cambiare Musica, la filosofia della musica dopo Adorno*.. Milano: LIM.
Dowilng, W. Jay & Harwood, Dane L. (1986), *Music Cognition*, New York: Academic Press
Gardiner, Jhon M. et al. (1990) The Tulving-Wiseman law and the recognition of recallable music, *Memory & Cognition*, vol.18, n.6, 632-637.
Halpern, Andrea R. Organization in Memory for Familiar Songs, *J.of Experimental Psychology: Learning, Memory , and Cognition*, vol. 10, n.3, 496-512.

Hartmann, W.M. and Johnson, D.(1991) Stram Segregation and Peripheral Channeling, *Music Perception*, vol.9, n.2, 155-184.
Murray Schafer, R. (1977) *The tuning of the world*, Toronto: McClelland and Stewart Ltd.

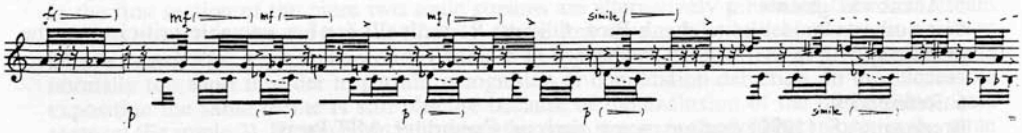


Ex. 1.



Ex. 2.

Ex. 3.



Ex. 4.